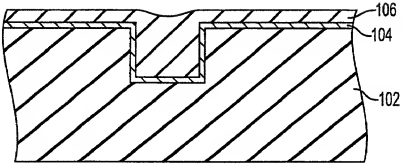

FIG. 1A
(PRIOR ART)

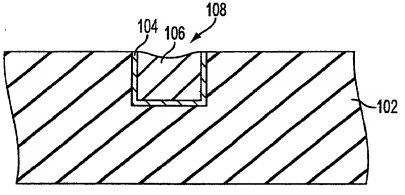

FIG. 1B
(PRIOR ART)

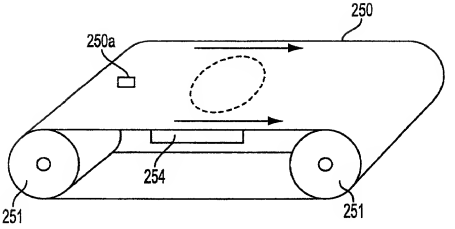

FIG. 2A

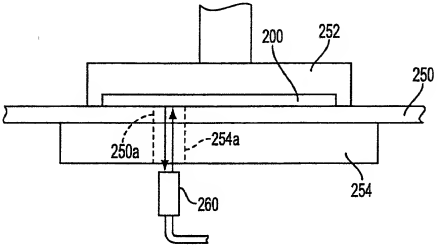

FIG. 2B

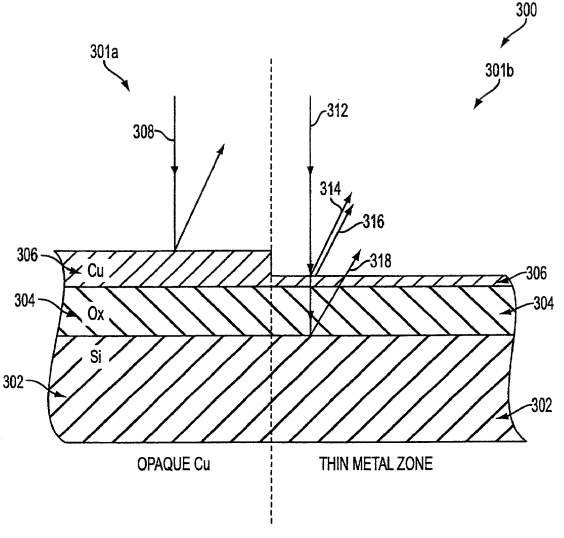
300
301a
301b
308
312
314
316
318
306
Cu
304
Ox
Si
302
306
304
302
OPAQUE Cu
THIN METAL ZONE

FIG. 3

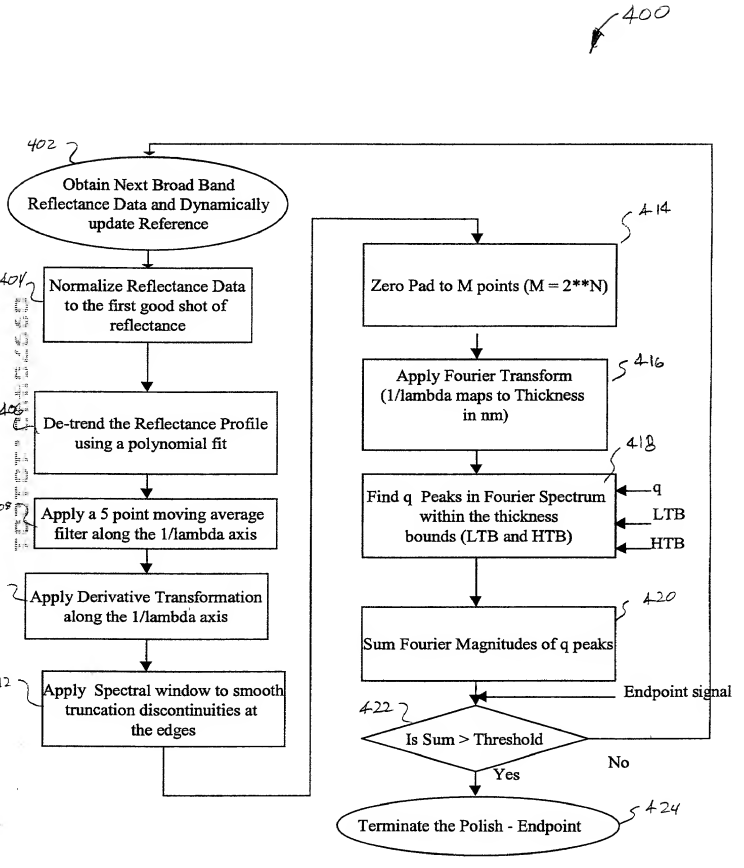
400
402
Obtain Next Broad Band Reflectance Data and Dynamically update Reference
404
Normalize Reflectance Data to the first good shot of reflectance
406
De-trend the Reflectance Profile using a polynomial fit
408
Apply a 5 point moving average filter along the 1/lambda axis
410
Apply Derivative Transformation along the 1/lambda axis
412
Apply Spectral window to smooth truncation discontinuities at the edges
414
Zero Pad to M points (M = 2**N)
416
Apply Fourier Transform (1/lambda maps to Thickness in nm)
418
Find q Peaks in Fourier Spectrum within the thickness bounds (LTB and HTB)
q
LTB
HTB
420
Sum Fourier Magnitudes of q peaks
Endpoint signal
422
Is Sum > Threshold
No
Yes
424
Terminate the Polish - Endpoint

FIG. 4

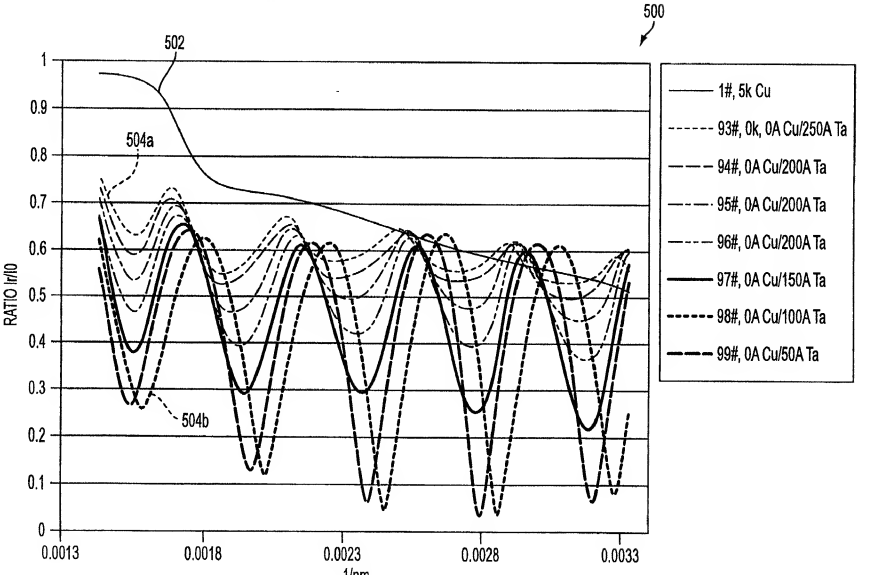
500
502
504a
504b
RATIO Ir/I0
1/nm
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
0.0013
0.0018
0.0023
0.0028
0.0033
1#, 5k Cu
93#, 0k, 0A Cu/250A Ta
94#, 0A Cu/200A Ta
95#, 0A Cu/200A Ta
96#, 0A Cu/200A Ta
97#, 0A Cu/150A Ta
98#, 0A Cu/100A Ta
99#, 0A Cu/50A Ta

FIG. 5

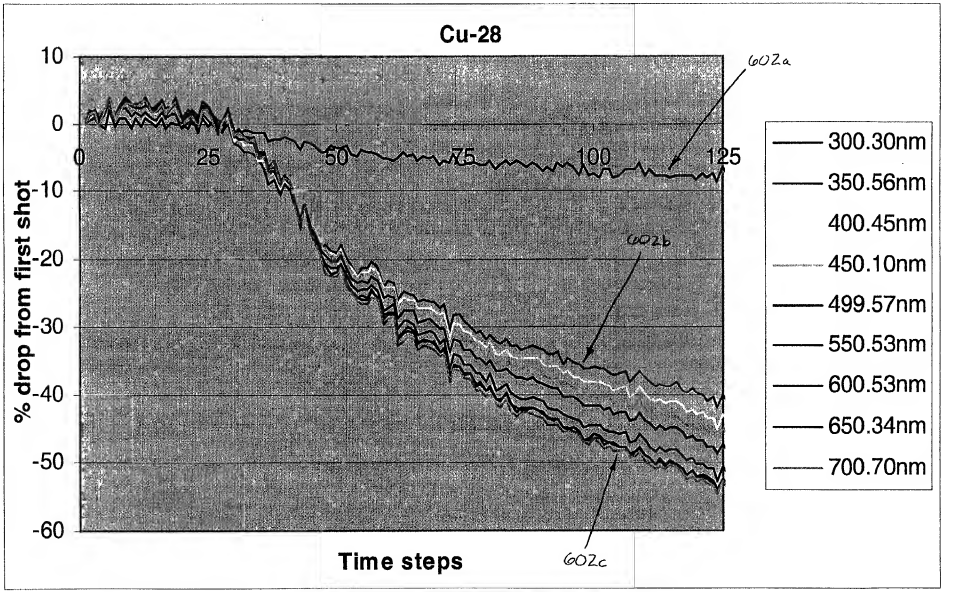
600
Cu-28
10
0
-10
-20
-30
-40
-50
-60
0
25
50
75
100
125
% drop from first shot
Time steps
602a
602b
602c
300.30nm
350.56nm
400.45nm
450.10nm
499.57nm
550.53nm
600.53nm
650.34nm
700.70nm

FIG. 6

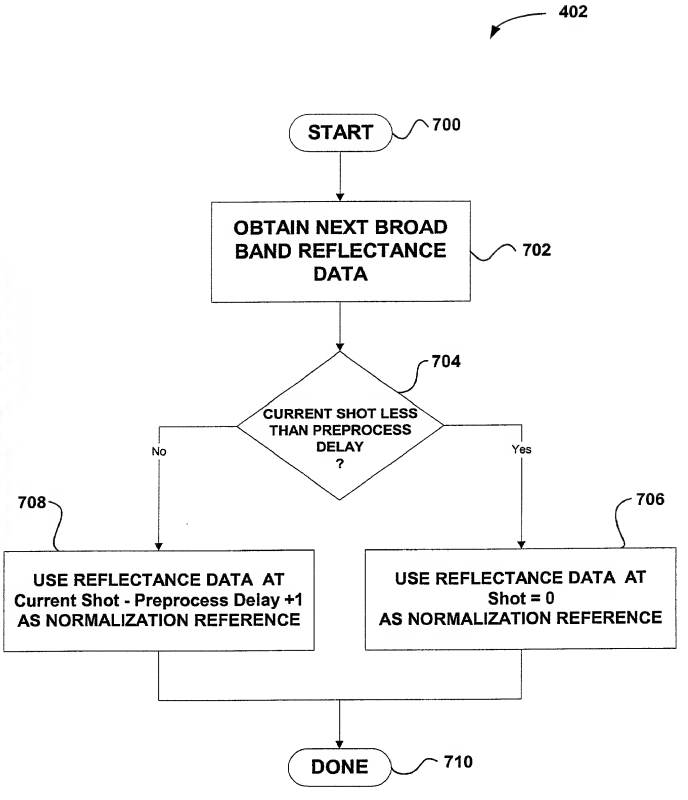
402
START
700
OBTAIN NEXT BROAD BAND REFLECTANCE DATA
702
704
CURRENT SHOT LESS THAN PREPROCESS DELAY ?
No
Yes
708
706
USE REFLECTANCE DATA AT Current Shot - Preprocess Delay +1 AS NORMALIZATION REFERENCE
USE REFLECTANCE DATA AT Shot = 0 AS NORMALIZATION REFERENCE
DONE
710

FIG. 7

PATENT PENDING

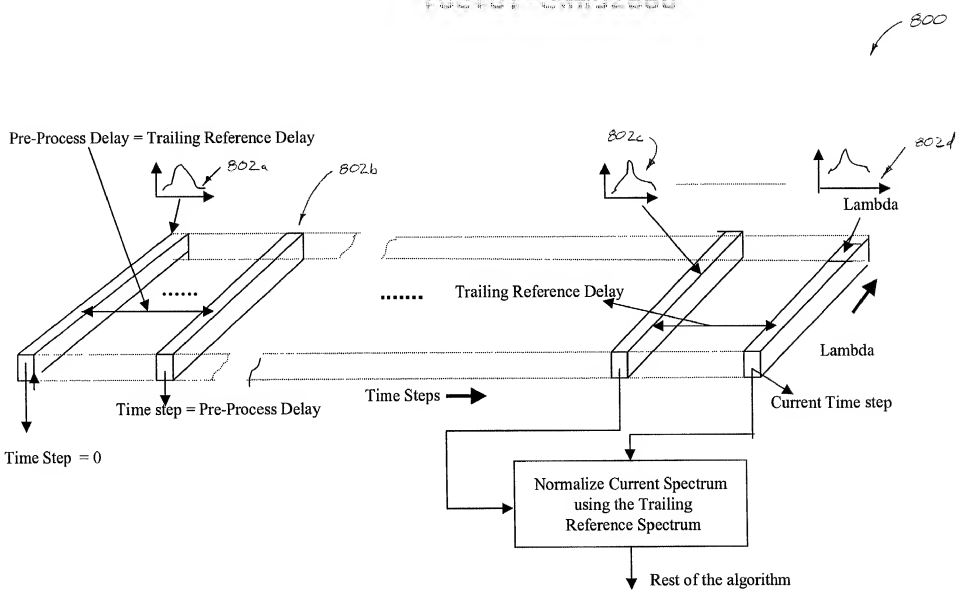

Fig. 8A

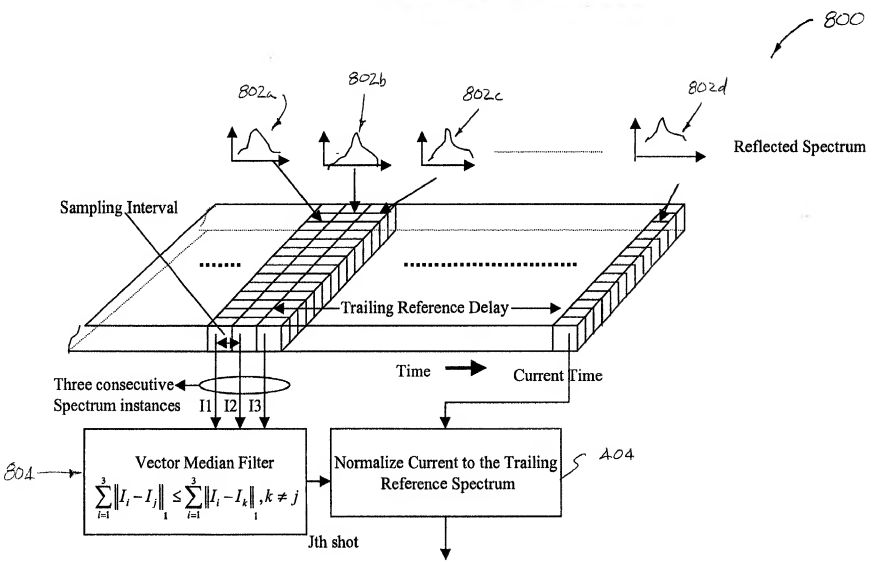
800
802a
802b
802c
802d
Reflected Spectrum
Sampling Interval
Trailing Reference Delay
Time
Current Time
Three consecutive
Spectrum instances
I1
I2
I3
801
Vector Median Filter
$\sum_{i=1}^{3}\|I_i - I_j\|_1 \le \sum_{i=1}^{3}\|I_i - I_k\|_1, k \neq j$
Jth shot
Normalize Current to the Trailing Reference Spectrum
804

Fig. 8B

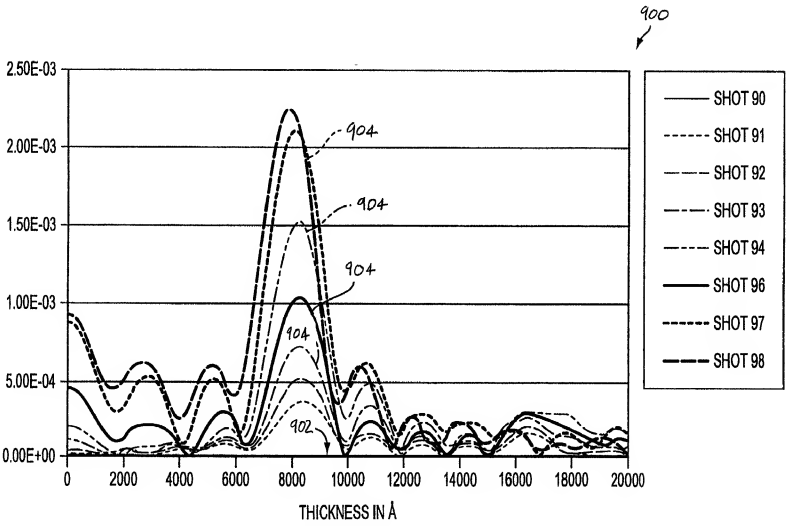
900
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
THICKNESS IN Å
904
904
904
904
902
SHOT 90
SHOT 91
SHOT 92
SHOT 93
SHOT 94
SHOT 96
SHOT 97
SHOT 98

Fig 9

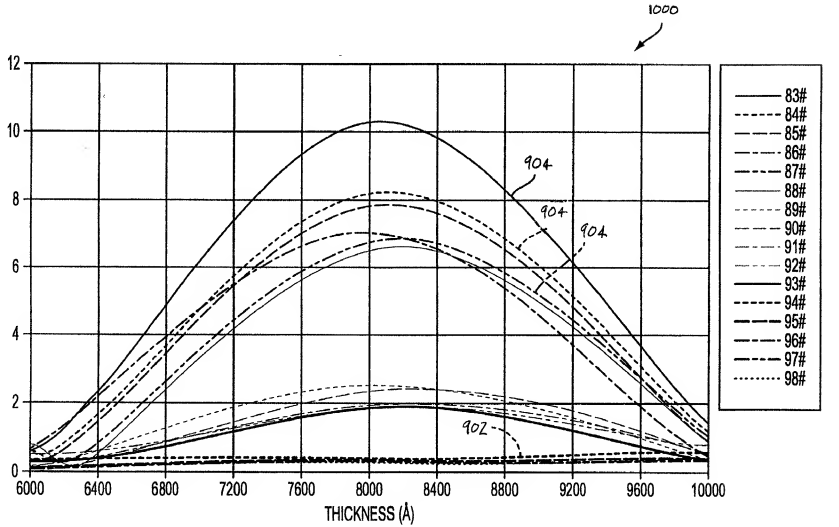
1000
12
10
8
6
4
2
0
6000
6400
6800
7200
7600
8000
8400
8800
9200
9600
10000
THICKNESS (Å)
904
904
904
902
83#
84#
85#
86#
87#
88#
89#
90#
91#
92#
93#
94#
95#
96#
97#
98#

Fig. 10

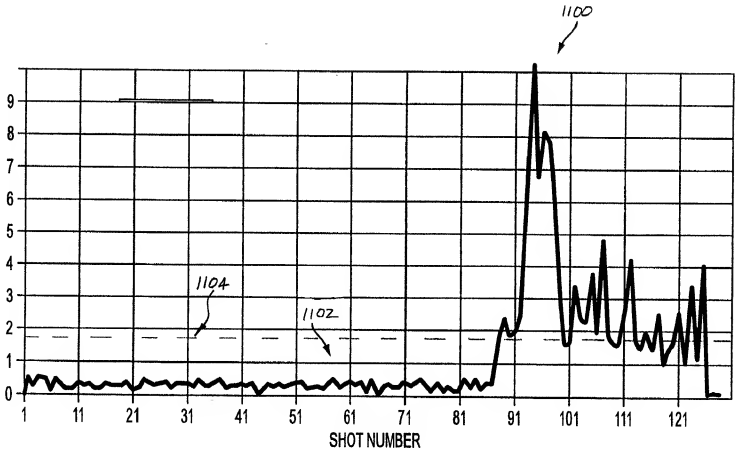
1100
9
8
7
6
5
4
3
2
1
0
1104
1102
1
11
21
31
41
51
61
71
81
91
101
111
121
SHOT NUMBER

Fig. 11

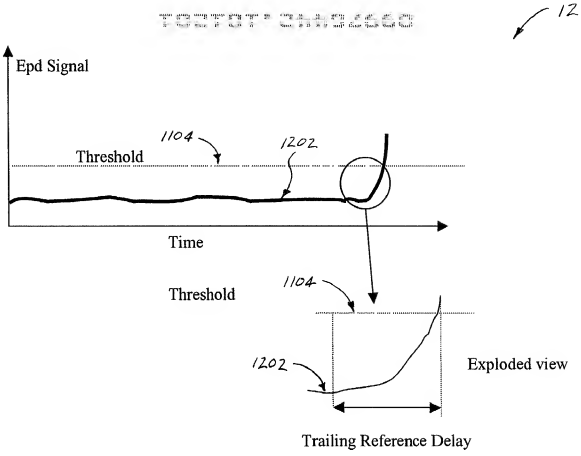
1200
Epd Signal
1104
Threshold
1202
Time
Threshold
1104
1202
Exploded view
Trailing Reference Delay

Fig. 12

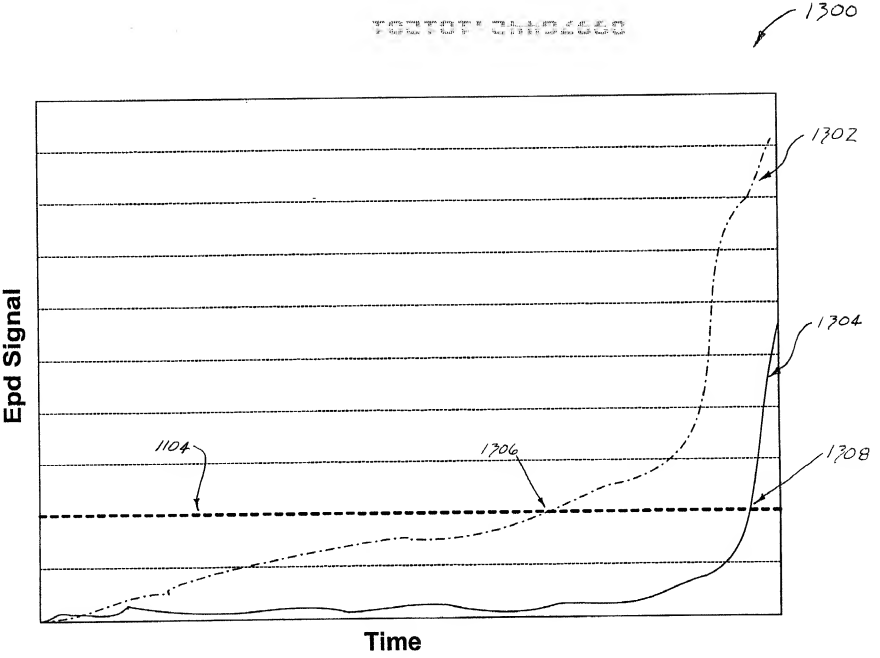

FIG. 13